THE CONTRA COSTA COUNTY POPULATION MODEL: AN APPLICATION OF THE COHORT SURVIVAL PROJECTION METHOD

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INTRODUCTION

The Contra Costa County Planning Department has developed a computer model to generate population projections of the county for the period 1980-2000. The model provides projections of both the total population and its composition by age and sex. This Technical Memorandum documents the rationale for developing the population model, the methodology and data, calibration procedures, and current and prospective applications.

The Need for Census Data

The importance of reliable estimates of current population was recognized early in the nation's history. Article I of the U. S. Constitution specifies that a census of population be taken every ten years: The actual Enumeration shall be made within three Years after the first Meeting of the Congress of the United States, and within every subsequent Term of ten Years, in such Manner as...(the Congress)...shall by Law direct.[1] Early census uses included verification that developing territories satisfied the 50,000-person requirement for statehood. In addition, individual Constitutional Founding Fathers had specific interests in the census. James Madison, for one, thought it would be useful for military recruitment purposes to determine the number of young men aged sixteen and over.[2] More generally, populations must be certified in order to apportion political representation among districts at the local and national level. Political apportionment is perhaps the most extensively litigated issue involving population data. Within the last two decades a line of court cases resulted in a landmark Supreme Court decision expanding the principle of "one man, one vote."[3]

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[1] In October, 1976 the U.S. Congress passed legislation (HR 11337) providing for a census of population to be taken every five years beginning in 1985.

[2] E. J. Kahn, Jr., The American People, (New York: 1973), p. 28

[3] Baker v. Carr 369 U. S. 186 (1961); Reynolds v. Sims, 377 U. S. 533 (1964). See generally, Shattschneider, "Urbanization and Reapportionment," Yale Law Journal 7 (1962).

Since the initial federal census in 1790 the decennial census has expanded from little more than a headcount--the first questionnaires included only five items--to a complex ongoing activity. The U. S. Bureau of the Census now compiles diverse data on business, agriculture, and social indicators, as well as conducting the decennial population count.[4] Beginning in 1985, the census of population will be conducted every five years.

To supplement the efforts of federal census takers, numerous state and local governments conduct special censuses at mid-decade or other times between federal censuses. In California, for example, numerous cities, and some thirty counties, including Contra Costa, conducted a 1975 Special Census of Population. These special censuses provide an important statistical bridge between the decennial federal censuses, and in many cases are an important means of obtaining State tax revenues. (See Note 6)

The 1975 Special Countywide Census of Contra Costa County was designed to provide a detailed update of the 1970 Federal Census. The special census follows a period when new cities were formed and several geographic areas of the county had experienced substantial population growth and change.[5] The Special Census enumerated population, housing structure and selected demographic characteristics. By its finding that several cities increased in population, the Special Census also provided the means for obtaining substantially higher tax revenue subventions under SB-90 tax legislation.[6]

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[4]For example, the U. S. Bureau of the Census conducts a Census of Agriculture in years ending in 4 and 9; its Census of Manufacturers is reported for years ending in 2 and 7.

[5]Cities in Contra Costa County incorporated since 1960 include Pleasant Hill (1961), Clayton (1964), Lafayette (1968), and Moraga (1974). Total Contra Costa County Population increased from 555,805 to 582,829 or 4.86% between 1970 and 1975.

[6]SB-90 is State tax redistribution legislation enacted in 1972. One of its key provisions involves the rebate of tax monies (e.g. locally-originated sales taxes, license fees, etc.) to cities and counties according to a per capita subvention formula. Populations upon which taxes are rebated must be officially certified by the State Department of Finance. Recognition of decennial federal census population figures is mandatory. Intercensal estimates or formal enumerations may be submitted to the State for certification at the discretion of local jurisdictions. In practice, cities and counties attempt to certify only population

Population Projections

As censuses of population serve diverse current needs of local and national jurisdictions, reliable projection of future populations indicate important future needs or demand for numerous types of facilities, social service programs, and commercial products.[7] Public and private facilities are typically intended to have a service lifespan of many years. Consequently, determination of appropriate capacity is vitally important if the facility is to have sufficient, but not excessive, capacity to meet expected demand.

Among the types of facilities for which population projections are an intrinsic part of the planning process are schools, hospitals, parks, sewerage treatment plants, and airports. In certain cases, determination of the age and sex composition is as important as projection of the total population. Educational facilities, for example, serve populations in specific age groups or cohorts. Other facilities such as maternity units within hospitals forecast demand for services based on both the size and sex of a specific segment of the population.

As a growing county, Contra Costa utilizes population projections to serve a wide variety of planning needs. One recent use of population projections has arisen from the advance planning of a new County Detention Facility. Based on incarceration rates for different age and sex cohorts, projected populations for

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counts which are successively higher than the previous federal census or other State-certified figures. Contra Costa County government and individual cities in the county now receive over $12 million annually from the State in population-related tax subventions.

[7] An increasingly important application of population estimates and projections is in conjunction with social indicators. Social indicators cluster individual indices such as population, income, housing conditions, and occupancy as single combined measures of need, such as housing or health need. Based on projections of certain population cohorts (e.g., elderly) it is possible to estimate future program needs. See for example, U. S. Bureau of the Census, Census Use Study, Social and Health Indicators System, Part II: Rural, Mound Bayou Mississippi. A more general overview of statistical data used to derive social indicators is: Federal Statistical System, Status: A Monthly Chartbook of Social and Economic Trends. The September 1976 issue (ST76-3) focuses on the elderly population.

different years were computed in order to derive alternative facility capacities.[8] In the future, population projections may be developed for geographic subareas of the county, such as cities and special districts.

[8]Contra Costa County Detention Facility Advisory Committee Report of the Internal Capacity Subcommittee, May 1976. See Section III and Appendix D, Capacity Projection Methodology.

METHODOLOGY

The County Population Model employs the cohort survival technique to derive its projections. Cohort survival is one of several methods used by demographers and planners to forecast total future population change and the composition of an area's population.[9] The technique is based on historic and current population data which is disaggregated by sex and age cohorts, usually in five-year intervals. Age/sex population cohorts for a base-year are the building blocks from which the projections are ultimately derived.

In addition to the 5-year age/sex cohorts for a base year, there are three other demographic components of the cohort survival model. These include: 1) survival rates, 2) age-specific fertility rates, and 3) migration by age and sex. The following sections examine each of these components individually.

Age/Sex Cohorts

Determination of age sex cohorts within the total population by five-year intervals is one basic data requirement of the cohort survival projection method. In some cases, such as for less-developed regions or countries, this distribution must be estimated. The Contra Costa County model initially used the 1960 U. S. Census as a base; this was supplemented by 1965 population estimates and subsequently by reports from the 1970 U. S. Census. This data was further supplemented by results from the 1975 Special Countywide Census. The 1975 population by age/sex cohort is displayed in Table 1.

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[9] See generally, William Goodman and Eric Freund, eds., Principles and Practices of Urban Planning, (Washington: International City Managers Association, 1972) Chapter 3, Population Studies.

TABLE 1
1975 CONTRA COSTA COUNTY POPULATION BY AGE-SEX COHORT

Cohort Age	Male	Female	Total
0-4	19,464	18,156	37,620
5-9	24,854	23,987	48,841
10-14	30,929	28,892	59,821
15-19	28,677	27,306	55,983
20-24	20,024	21,029	41,053
25-29	22,288	24,226	46,514
30-34	21,914	23,447	45,361
35-39	18,985	19,470	38,455
40-44	17,855	18,347	36,202
45-49	17,694	18,058	35,752
50-54	18,640	19,266	37,906
55-59	14,716	14,352	29,068
60-64	10,999	11,353	22,352
65-69	8,166	9,552	17,718
70-74	5,126	6,816	11,942
75-79	3,148	4,846	7,994
80-84	1,742	3,033	4,775
85+	1,054	2,108	3,162
TOTALS	286,275*	294,244*	580,519*

*Totals exclude military shipboard population at the time the census was conducted, April, 1975. Total county population including the military and shipboard element was 582,829.

Source: 1975 Special Census of Contra Costa County.

Survival Rates

In general, survival rates express survival from a younger age to an older age.[10] In mathematical terms, this may be stated as the proportion of individuals at a given age that survives to a subsequent age. With regard to the cohort survival model, survival rates refer to survival "forward" in time from one 5-year cohort to the next. The general formula for a 5-year survival rate is:

$$S_i = \frac{P_{x+5}}{P_x}$$

where: S_i is the survival rate for cohort i

P_x is the population P of the 5-year cohort with base year x; and

P_{x+5} is the expected or "survived" population in year x + 5

Shryock and Siegel (1973) provide the following example of an application of the survival rate formula from the 1959-61 U. S. life table. The proportion of the population 45 to 49 years of age which will survive 5 years is:

$$S = \frac{434,264}{450,814} = 0.96329$$

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[10] As Shryock and Siegel note, survival rates may be used to restore deaths to an older population; i.e., the initial population can be calculated if the terminal population and its survival rate are known. For this "reverse survival rate" the terminal population is divided by the survival rate. This procedure is used very infrequently relative to forward survival rates. Henry S. Shryock, Jacob S. Siegel, and Associates, The Methods and Materials of Demography, U. S. Department of Commerce, 1973.

Survival rates such as in the above example are calculated and periodically updated. Survival rates in industrial nations have tended downward in many age cohorts as medical technology, nutrition, and health care have improved. The survival rates used for the County Population Model are based on the latest U. S. Census national series. As of 1973, these national rates were adopted up to and including ages 60-64, but beyond this, age-specific survival rates used in the Population Model are based on 1970 California rates. The California rates were prepared and published by the California Department of Public Health. The 1970 survival rates used in the Population Model are displayed in Table 2. Projected survival rates for five-year periods between 1975-2000 are shown in Table 3.

Survival rates are used as one factor in the Population Model to calculate the age composition of future populations. Five-year survival rates are multipled by base year populations in order to derive the population projection. Mathematically, a future population is stated as:

$$P_{x+5}^{t+5} = S_x * P_x^t$$

where: P_{x+5}^{t+5} is the expected future population;

S_x is the 5-year survival rate; and

P_x^t is the base year population

Cohort populations projected using survival rates are adjusted to reflect expected net migration and births in future time periods. Estimation of future migration and births is discussed in a subsequent section of the paper. Once the exogenous migration and birth adjustements are made, the cohort projections are complete.

TABLE 2
1965-1970 BASE YEAR SURVIVAL RATES

Age	5-Year Survival Rates MALE	FEMALE
0-4	0.99600	0.99697
5-9	0.99755	0.99845
10-14	0.99782	0.99857
15-19	0.99299	0.99684
20-24	0.99002	0.99636
25-29	0.99115	0.99574
30-34	0.99032	0.99423
35-39	0.98665	0.99159
40-44	0.97894	0.98673
45-49	0.96583	0.97953
50-54	0.94576	0.97000
55-59	0.91721	0.95740
60-64	0.87597	0.93861
65-69	0.82155	0.90689
70-74	0.75473	0.84743
75-79	0.65747	0.76607
80-84	0.52559	0.63132
85+	0.31833	0.35129

Source: U. S. Bureau of Census,
Report Series P-25, No. 601.

TABLE 3
PROJECTED SURVIVAL RATES FOR CONTRA COSTA COUNTY: 1975-2000

Males

Initial Age	Terminal Age	1975-80	1980-85	1985-90	1990-95	1995-2000	2000+
Birth	Under 5	.980568	.981780	.982843	.983813	.984750	.985331
Under 5	5-9	.996687	.996749	.996811	.996873	.996936	.996998
5-9	11-14	.998061	.998091	.998121	.998158	.998191	.998211
10-14	15-19	.995056	.995135	.995092	.995328	.995322	.995323
15-19	20-24	.990373	.990437	.990554	.990610	.990810	.990901
20-24	25-29	.989901	.990060	.990241	.990390	.990566	.990684
25-29	30-34	.990559	.990718	.990933	.991154	.991379	.991552
30-34	35-39	.988505	.988915	.989136	.989410	.989680	.989944
35-39	40-44	.983123	.983796	.984336	.984644	.985007	.985264
40-44	45-49	.972836	.973738	.974580	.975278	.975722	.976057
45-49	50-54	.957040	.957876	.959086	.960207	.961179	.961578
50-54	55-59	.933383	.934549	.935645	.937238	.938696	.939567
55-59	60-64	.899862	.901113	.902657	.904110	.906192	.907456
60-64	65-69	.852301	.854666	.855962	.857725	.859368	.861053
65-69	70-74	.829201	.833682	.838163	.842644	.847125	.851605
70-74	75-79	.764138	.768267	.772396	.776525	.780654	.784785
75-79	80-84	.662905	.666487	.670069	.673651	.677233	.680817
80-84	85-89	.551629	.554610	.557591	.560572	.563553	.566533
85+	90+	.334097	.335903	.337709	.339515	.341321	.343124

Females

Initial Age	Terminal Age	1975-80	1980-85	1985-90	1990-95	1995-2000	2000+
Birth	Under 5	.984689	.985645	.986473	.987225	.987952	.988417
Under 5	5-9	.997442	.997451	.997572	.997663	.997738	.997776
5-9	10-14	.998523	.998556	.998585	.998626	.998660	.998681
10-14	15-19	.997784	.997844	.997871	.997976	.998019	.998045
15-19	20-24	.996683	.996772	.996864	.996944	.997054	.997131
20-24	25-29	.996368	.996488	.996608	.996727	.996834	.996941
25-29	30-34	.995455	.995578	.995728	.995871	.997033	.996120
30-34	35-39	.993414	.993689	.993854	.994055	.994246	.994418
35-39	40-44	.989939	.990337	.990661	.990848	.991076	.991236
40-44	45-49	.984169	.984695	.985210	.985636	.985895	.986126
45-49	50-54	.976437	.976954	.977667	.978361	.978952	.979220
50-54	55-59	.965977	.966701	.967433	.968396	.969318	.969886
55-59	60-64	.950870	.951968	.953072	.954186	.955584	.956503
60-64	65-69	.930779	.932769	.934272	.935786	.937323	.938526
65-69	70-74	.911595	.913006	.914417	.915828	.917239	.918649
70-74	75-79	.866311	.867652	.868993	.870334	.871675	.873014
75-79	80-84	.779625	.780828	.782031	.783234	.784437	.785661
80-84	85-89	.658619	.659638	.660657	.661676	.662695	.663716
85+	90+	.366495	.367062	.367629	.368196	.368763	.369331

Source: U.S. Census Bureau, California Department of Public Health, Contra Costa County Planning Department.

Age-Specific Birth Rates

An age specific birth rate is defined as the number of births per 1,000 women in a given age cohort during a given year. As with survival rates, age specific birth rates are often stated for 5-year age cohorts. The formula for age specific fertility is expressed:

$$f_a = \frac{B_a}{P_a} \times 1000$$

where: f_a is the number of births per 1,000 women in age cohort a;
B_a is the number of births to women in age group a, and
p_a is the total population of women in age cohort a.

Age-specific fertility is most often calculated in 5-year intervals for women age 15-44 only. Illustrated below is an example of how a single year age-specific birth rate for women of ages 20-24 is calculated.

The total fertility rate for an area is the projected sum of age specific birth rates of women during their reproductive lifespan (ages 15 to 44 or alternately, ages 15 to 49). It expresses the number of births per 1,000 women under the assumption that age-specific birth rates in a selected year will be constant. Stated in terms of the individual women, total fertility is the equivalent estimate of completed family size. Viewed over time, individual total fertility thus provides an easily understood indicator of changes in lifestyle and family preferences among women.[11]

[11] A number of economists, most notably Gary Becker, have argued that a primary determinant of family size is social context. In part, the current period of low fertility thus reflects the strong anti-natalist sentiments which have emerged during the last decade. Becker's argument is complemented by the higher economic costs associated with large family size and the observed preference among women for extended labor force participation. Further, social and medical barriers to contraception have diminished substantially. Becker's arguments are challenged by demographer Judith Blake in her article, "Are Babies Consumer Durables?", Demography, October 1968.

For 5-year age-cohorts the total fertility rate is expressed:

$$TFR = 5 \sum_{i=1}^{7} \frac{B_i}{P_i} * 1{,}000$$

where there are seven age intervals, e.g. 15-19, 20-24, etc.,
Bi is the number of live births to women in age cohort i, and
Pi is the mid-year population of women in age cohort i.

The factor 5 in the expression expands the single year fertility rate to five successive years. The Contra Costa County Population model incorporates both age specific birth rates and total fertility rates in its projections.

National and Contra Costa County Fertility Rates

Tables 4, 5 and 6 provide data regarding the relationships between national and county fertility rates. Table 4 reports national estimates of total fertility and age specific birth rates for selected years between 1960 and 1975. Table 5 reports comparable data for Contra Costa County. Table 6 expresses Contra Costa County fertility and birth estimates as ratios to the national data.

Tables 4, 5 and 6 suggest a number of notable distinctions between fertility in Contra Costa County and the rest of the nation. Examining the data in Table 4 and Table 5, it is apparent that total fertility (completed family size) and age specific birth rates have been declining over time. For example, the nation's total fertility rate dropped from 3.61 in 1960 to 1.80 in 1975. The 1960-1975 fertility decline in Contra Costa County was even steeper, moving from 3.70 to 1.58. In general, Contra Costa County has experienced lower total and age specific fertility than the rest of the nation. The average ratios of county to national age-specific birth rates displayed by Table 6 range from a low of 0.5712 (Ages 40-44) to a high of 0.9716 (Ages 25-29). During previous years in certain age cohorts county birth rates have exceeded national estimates. In 1960, for example, this was true for the 20-24 and 25-29 age cohorts. However, the last year in which a county age-specific birth rate exceeded a national estimate was in 1965, for ages 20-24.

TABLE 4
NATIONAL ESTIMATES OF TOTAL
FERTILITY AND AGE-SPECIFIC BIRTH RATES

Year	Total Fertility Rate	Birth Rates 15-19	20-24	25-29	30-34	35-39	40-44
1960	3608.4	90.3	249.8	195.4	113.1	56.8	16.4
1965	2884.7	73.0	192.4	157.4	93.7	46.6	13.7
1970	2434.1	70.5	164.6	139.4	71.6	32.0	8.8
1971	2249.1	67.0	150.4	129.7	66.1	28.8	7.8
1972	1997.0	64.4	129.7	115.1	58.5	24.9	6.8
1973	1868.6	61.8	120.0	109.4	54.3	22.3	6.0
1974	1856.6	59.3	119.0	113.3	54.4	20.2	5.1
1975	1799.0	57.6	114.7	110.3	53.1	19.4	4.9

Source: U.S. Bureau of Census Report, P-25 Number 601, October, 1975.

TABLE 5
CONTRA COSTA COUNTY ESTIMATES OF TOTAL
FERTILITY AND AGE-SPECIFIC BIRTH RATES

Year	Total Fertility Rate	Age-Specific Birth Rates 15-19	20-24	25-29	30-34	35-39	40-44
1960	3698.5	88.4	288.7	198.4	104.5	47.2	12.5
1965	2691.0	77.9	192.8	140.2	76.7	39.1	11.5
1970	2187.5	56.5	155.7	134.7	65.6	20.9	4.1
1971	1932.5	44.8	136.5	126.0	55.6	19.4	4.2
1972	1805.5	44.1	126.9	115.3	54.0	17.1	3.7
1973	1601.5	36.6	108.2	108.0	50.7	13.8	3.0
1974	1579.9	37.4	108.5	104.1	48.2	14.7	2.4
1975	1582.0	37.4	108.9	103.4	51.3	13.2	2.2
1976	1604.0	36.2	108.0	107.8	51.8	15.0	2.0

Source: Contra Costa County Planning Department, California State Department of Health.

TABLE 6
RATIOS OF CONTRA COSTA COUNTY FERTILITY
AND AGE-SPECIFIC BIRTH RATES TO NATIONAL RATES

Year	Ratio of Total Fertility	Ratios of County to National Birth Rate 15-19	20-24	25-29	30-34	35-39	40-44
1960	1.0250	0.9790	1.1557	1.0164	0.9240	0.8310	0.7622
1965	0.9329	1.0671	1.0021	0.9807	0.8186	0.8391	0.8394
1970	0.9887	0.8014	0.9459	0.9663	0.9162	0.6531	0.4659
1971	0.8592	0.6687	0.9076	0.9715	0.8411	0.6736	0.5385
1972	0.9041	0.6848	0.9784	1.0017	0.9231	0.6867	0.5441
1973	0.8571	0.5922	0.9017	0.9872	0.9337	0.6188	0.5000
1974	0.8510	0.6307	0.9118	0.9118	0.8860	0.7277	0.4706
1975	0.8794	0.6493	0.9494	0.9374	0.9661	0.6804	0.4490
Average	0.9122	0.7592	0.9691	0.9716	0.9011	0.7138	0.5712

Source: Contra Costa County Planning Department.

Total Fertility Projections

Projections of the county's total fertility rate and age-specific birth rates were developed for the period 1975-2020. These projections were based upon national fertility projections developed by the Census Bureau (see Table 7). County rates were derived by modifying the national rates to reflect Contra Costa County's unique fertility timing patterns and the county's lower overall fertility rates. This was achieved by multiplying the national age-specific birth rates (Table 7) by the corresponding average county to nation birth rate ratios from Table 6 for each age group and time period. For example, all projected national age-specific birth rates for the 40-44 age cohort were multiplied by 0.5712 to derive county rates. Total fertility rate projections for the county were developed by multiplying national rates (Table 7) by the average county to nation ratio of total fertility (Table 6). The resultant fertility rates were checked against the age-specific birth rates, to ensure that they were consistent with one another (the sum of the age-specific birth rates for a given 5-year period multiplied by 5 should equal total fertility rate for that period). In some instances, minor discrepancies were found. These were eliminated by adjusting the age-specific birth rates to conform to the total fertility rate.

Three alternative series of national fertility projections for the period 1975-2020 (Table 7) were utilized to develop fertility projections for Contra Costa County. Series 1 is the highest of the national fertility rates. Its 1975-80 level is 2.2 births per woman per lifetime, slightly above replacement (2.1). The rate increases to 2.7 lifetime births by 1990-95 and maintains this level for the remainder of the projection period. The series implies general economic prosperity and a return to previous family formation patterns. Series 2 is the medium fertility level for the nation and is assumed to be the most probable outcome. It assumes a return to replacement fertility of 2.1 by 1990-95. The series also assumes that household formation rates (marriages) and birth expectations (vis a vis the two child norm) will return to a level prevalent in the 1971-1972 period. Series 3 is the low rate for the nation. Its assumption is that the future fertility level will continue below replacement, at about 1.7. Further, this series assumes a substantial permanent change in family formation

TABLE 7
PROJECTED NATIONAL AGE-SPECIFIC BIRTH RATES
SERIES 1, 2, AND 3

Total Fertility Rate	Age-Specific Birth Rates 15-19	20-24	25-29	30-34	35-39	40-44	Series	Time Period
2172.0	67.9	148.1	130.8	59.6	22.2	5.8	1	1975-1980
2472.7	67.6	171.4	157.8	68.4	23.4	6.0	1	1980-1985
2638.7	64.6	179.9	175.6	76.7	24.7	6.1	1	1985-1990
2703.2	62.0	183.2	181.6	81.4	26.0	6.4	1	1990-1995
2711.0	60.3	184.6	183.8	80.3	26.0	6.6	1	1995-2000
2705.0	59.8	185.2	185.5	79.8	24.4	6.3	1	2000-2005
2702.7	59.7	185.5	186.7	79.6	23.2	5.8	1	2005-2010
2701.7	59.6	185.6	187.1	79.6	22.7	5.6	1	2010-2015
2700.0	59.6	185.6	187.1	79.6	22.6	5.6	1	2015-2020
1916.5	58.9	127.7	116.2	54.2	20.7	5.5	2	1975-1980
2045.5	55.9	138.1	129.7	59.0	21.0	5.4	2	1980-1985
2095.2	51.9	141.8	136.9	62.0	21.2	5.3	2	1985-1990
2111.0	49.0	143.2	140.8	63.0	21.0	5.2	2	1990-1995
2109.5	47.2	144.0	142.8	62.6	20.2	5.1	2	1995-2000
2106.0	46.6	144.4	144.4	62.0	18.9	4.8	2	2000-2005
2105.2	46.5	144.8	145.5	62.0	18.0	4.5	2	2005-2010
2102.7	46.5	144.5	145.6	62.0	17.7	4.3	2	2010-2015
2100.0	46.4	144.4	145.5	61.9	17.6	4.3	2	2015-2020
1707.7	52.7	112.1	102.5	49.3	19.6	5.2	3	1975-1980
1716.0	47.5	114.8	107.4	50.0	18.6	4.9	3	1980-1985
1710.5	43.0	115.5	110.5	50.5	17.8	4.6	3	1985-1990
1709.5	40.6	116.1	113.1	50.5	17.1	4.4	3	1990-1995
1706.7	38.9	116.6	115.2	50.3	16.2	4.1	3	1995-2000
1703.2	37.8	116.9	116.8	50.1	15.2	3.9	3	2000-2005
1704.2	37.7	117.0	117.8	50.1	14.6	3.6	3	2005-2010
1702.0	37.5	116.9	117.9	50.2	14.3	3.5	3	2010-2015
1700.0	37.5	116.8	117.8	50.1	14.2	3.5	3	2015-2020

NOTE: Rates are five year averages based on published single year rates.

Source: U.S. Census Bureau, Publication Series P-25, Number 601, October, 1975.

rates and birth expectations in that a large percentage of the population will choose not to marry, and those who do marry will maintain the low birth expectations of the present.

Three corresponding series of county fertility rates were derived from the three national series (see Table 8). These series represent probable maximum (Series 4) and minimum (Series 6) rates, and a mid-range set of rates (Series 5) representing the most probable future experience. In addition, two intermediate series (Series 7 and 8, Table 9) were developed by averaging the Series 4 and 5 and Series 5 and 6 rates. The Series 7 rates developed by this method show a gradual rise in total fertility to approximately replacement level, 2.1 births per woman, and represent a zero-population growth series.

The projected age-specific birth rates are utilized in the population model to project total births. However, it is also necessary to determine how many of those births are male births and how many are female. This is done by specifying the ratio of male births to female births. Projections of this ratio were obtained from the State Department of Finance Population Research Unit, which projects a ratio of 0.5162 through the year 2020.

Migration

The final factor considered in projection of population change in an area is net migration. Net migration is defined as the numeric difference between persons moving into an area and those moving out of an area during a specified time period. Net migration was derived for the Contra Costa County Population Model using the survival rate method.

The survival rate method of projecting migratory population involves several steps. First, the age-sex distribution of the total study area population for at least two five-year time periods must be known. Data for the periods 1960-65, 1965-70, and 1970-75 were selected for the Contra Costa County model. From the initial year of each of these periods, observed fertility rates and survival

TABLE 8
PROJECTED COUNTY AGE-SPECIFIC BIRTH RATES
SERIES 4, 5, AND 6

Total Fertility Rate	Age-Specific Birth Rates 15-19	20-24	25-29	30-34	35-39	40-44	Series	Time Period
1981.0	51.6	144.0	127.4	53.9	16.0	3.3	4	1975-1980
2255.0	51.0	165.8	152.8	61.3	16.7	3.4	4	1980-1985
2406.5	48.6	173.4	169.5	68.7	17.6	3.5	4	1985-1990
2465.5	46.6	176.4	175.1	72.8	18.5	3.7	4	1990-1995
2472.5	45.3	177.8	177.2	71.8	18.6	3.8	4	1995-2000
2467.0	45.1	177.8	178.4	71.3	17.2	3.6	4	2000-2005
2465.0	44.7	178.1	179.5	71.0	16.0	3.3	4	2005-2010
2464.0	44.7	178.1	179.8	71.0	16.0	3.2	4	2010-2015
2463.5	44.7	178.1	179.8	71.0	15.9	3.2	4	2015-2020
1748.0	44.8	124.4	113.4	49.1	14.8	3.1	5	1975-1980
1865.5	42.3	133.7	125.8	53.2	15.0	3.1	5	1980-1985
1911.0	39.1	137.0	132.4	55.6	15.1	3.0	5	1985-1990
1925.0	36.9	137.9	135.8	56.4	15.0	3.0	5	1990-1995
1924.0	35.4	138.6	137.6	56.0	14.3	2.9	5	1995-2000
1920.5	35.0	138.7	138.9	55.4	13.4	2.7	5	2000-2005
1920.0	34.8	138.8	139.7	55.3	12.8	2.6	5	2005-2010
1917.5	34.8	138.6	139.8	55.3	12.5	2.5	5	2010-2015
1915.0	34.7	138.4	139.7	55.2	12.5	2.5	5	2015-2020
1557.5	40.2	109.4	100.1	44.7	14.1	3.0	6	1975-1980
1565.0	36.0	111.5	104.4	45.0	13.3	2.8	6	1980-1985
1560.0	32.5	111.7	107.1	45.4	12.7	2.6	6	1985-1990
1559.0	30.5	112.0	109.3	45.3	12.2	2.5	6	1990-1995
1556.5	29.2	112.2	111.1	45.0	11.5	2.3	6	1995-2000
1553.5	28.3	112.3	112.4	44.7	10.8	2.2	6	2000-2005
1554.5	28.3	112.5	113.4	44.7	10.3	1.7	6	2005-2010
1552.0	28.1	112.1	113.3	44.7	10.2	2.0	6	2010-2015
1550.5	28.1	112.1	113.3	44.6	10.0	2.0	6	2015-2020

NOTE: Rates are five year averages based on published single year rates.

Source: U.S. Census Bureau, Publication Series P-25, Number 601, October, 1975.

TABLE 9
PROJECTED AGE-SPECIFIC BIRTH RATES
SERIES 7 AND 8, AVERAGED FROM SERIES 4, 5, AND 6

Total Fertility Rate	Age-Specific Birth Rates 15-19	20-24	25-29	30-34	35-39	40-44	Series	Time Period
1864.5	48.2	134.2	120.4	51.5	15.4	3.2	7	1975-1980
2060.2	46.7	149.7	139.3	57.3	15.8	3.2	7	1980-1985
2158.8	43.9	155.2	150.9	62.2	16.3	3.3	7	1985-1990
2195.2	41.8	157.1	155.5	64.6	16.7	3.4	7	1990-1995
2198.3	40.3	158.2	157.4	63.9	16.5	3.4	7	1995-2000
2193.7	40.0	158.3	158.6	63.4	15.3	3.1	7	2000-2005
2192.5	39.8	158.4	159.6	63.2	14.6	2.9	7	2005-2010
2190.7	39.7	158.4	159.8	63.1	14.3	2.8	7	2010-2015
2189.3	39.7	158.3	159.8	63.1	14.2	2.8	7	2015-2020
1652.7	42.5	116.9	106.8	46.9	14.4	3.0	8	1975-1980
1715.3	39.2	122.6	115.1	49.1	14.1	3.0	8	1980-1985
1735.5	35.8	124.3	119.8	50.5	13.9	2.8	8	1985-1990
1742.0	33.7	124.9	122.6	50.8	13.6	2.8	8	1990-1995
1740.2	32.3	125.4	124.3	50.5	12.9	2.6	8	1995-2000
1737.5	31.7	125.5	125.7	50.1	12.1	2.4	8	2000-2005
1737.2	31.5	125.7	126.5	50.0	11.6	2.1	8	2005-2010
1734.8	31.5	125.3	126.6	50.0	11.3	2.3	8	2010-2015
1732.7	31.4	125.2	126.5	49.9	11.3	2.2	8	2015-2020

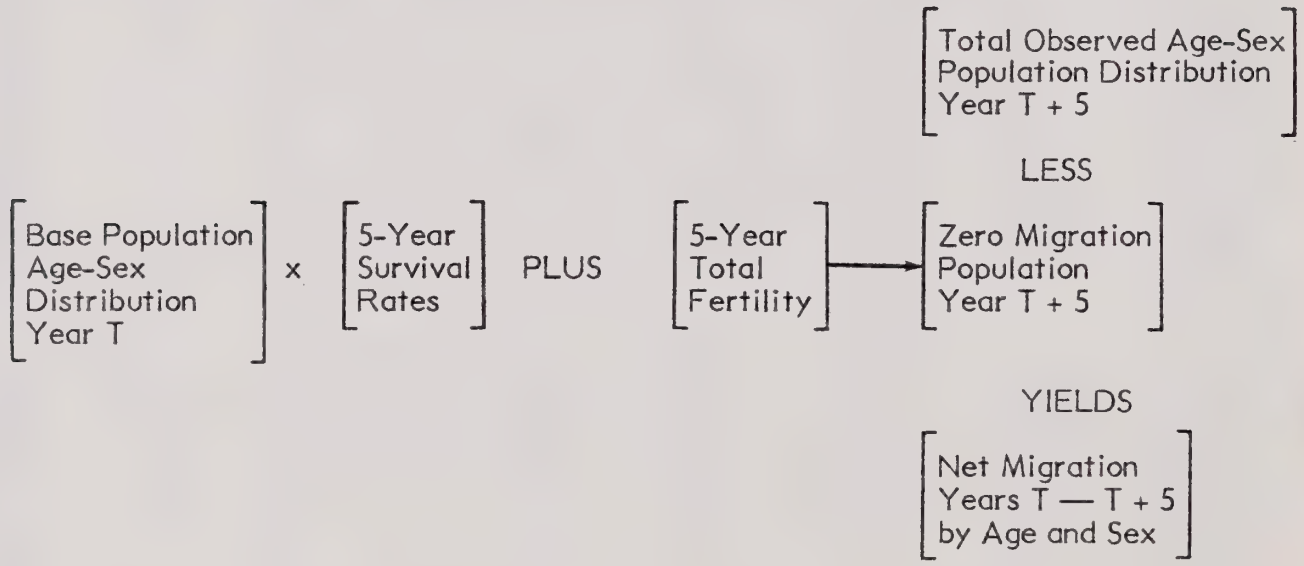
NOTE: Rates are five year averages based on published single year rates.

Source: U.S. Census Bureau, Contra Costa County Planning Department.

rates were used to calculate a "zero migration" population for each age-sex cohort. As represented by Figure 1, net migration for each age-sex cohort is the residual of the actual population less the calculated zero-migration population. The migration or "residual" populations and the age-sex percentage distributions were calculated for the three 5-year calibration periods.

FIGURE 1

DERIVATION OF NET MIGRATION USING THE SURVIVAL RATE METHOD



The steps necessary to calculate net migration are further illustrated by Tables 10 and 11. Table 10 presents data for 1965-1970 migration. Shown for each population age cohort are observed 1970 population, 1970 survival population, 1965-1970 net migration, and the percentage distribution of the net migration.

The second element included within 1970 Survived Population is net change due to births and deaths. This natural increase, as it is referred to, reflects fertility assumptions. In the case of historic calculations of migration, the natural increase factor is based on actual data. Shown in Table 11 are the age specific fertility rates used to calibrate migration for the three five-year periods between 1960 and 1975.

TABLE 10
DERIVATION OF COUNTY NET MIGRATION
AGE DISTRIBUTION: 1965-1970

Age	1970 Population	1970 Survived Population[1]	1965-1970 Net Migration[2]	Percent Distribution
MALES	273,474	254,362	19,112	48.3
0-4	23,298	21,126	2,172	5.5
5-9	29,726	25,972	3,754	9.5
10-14	31,115	28,772	2,343	5.9
15-19	26,901	27,892	-991	-2.5
20-24	18,337	22,265	-3,928	-9.9
25-29	17,936	12,322	5,614	14.2
30-34	16,809	12,531	4,278	10.8
35-39	16,446	12,814	3,632	9.2
40-44	17,919	16,373	1,546	3.9
45-49	19,240	19,145	95	0.2
50-54	16,408	15,741	667	1.7
55-59	13,310	13,453	-143	-0.4
60-64	9,508	9,332	176	0.4
65-69	6,392	6,922	-530	-1.3
70-74	4,418	4,220	198	0.5
75-79	2,958	2,833	125	0.3
80-84	1,652	1,819	-167	-0.4
85+	1,101	834	267	0.7
FEMALES	282,331	261,884	20,447	51.7
0-4	22,815	19,916	2,899	7.3
5-9	28,623	24,914	3,709	9.4
10-14	30,433	27,910	2,523	6.4
15-19	25,959	27,223	-1,264	-3.2
20-24	19,890	22,055	-2,165	-5.5
25-29	19,477	14,074	5,403	13.7
30-34	17,670	13,769	3,901	9.9
35-39	17,149	14,731	2,418	6.1
40-44	18,923	17,826	1,097	2.8
45-49	20,117	20,565	-448	-1.1
50-54	16,491	15,868	623	1.6
55-59	12,891	13,030	-139	-0.4
60-64	9,731	9,173	558	1.4
65-69	7,472	6,953	519	1.3
70-74	5,870	5,375	495	1.3
75-79	4,290	4,065	225	0.6
80-84	2,671	2,875	-204	-0.5
85+	1,859	1,564	295	0.7
TOTAL	555,805	516,246	39,559	100.0%

[1]Total 1970 survived population is equal to the sum of each male and female population cohort in 1965, multiplied by its respective five-year survival rate. Mathematically, this may be stated as:

$$\sum_{i=1}^{18} C_i S_i + \sum_{j=1}^{18} C_j S_j$$

where C_i and C_j are the male and female cohorts and S_i and S_j are the corresponding survival rates.

[2]Net migration 1965-1970 is the difference between observed 1970 population and 1965 survived population. See Note 1 above.

TABLE 11
COUNTY AGE-SPECIFIC FERTILITY RATES AND
COMPUTED NET MIGRATION: 1960-1975

Time Period	Total Fertility	Age-Specific Fertility Rates (births per 1000 women per year) 15-19	20-24	25-29	30-34	35-39	40-44	Computed Net Migration
1960-1965	3.1939	83.2	240.5	169.5	90.5	43.1	12.0	49,312
1965-1970	2.4384	67.3	174.0	137.6	71.1	29.9	7.8	39,559
1970-1975	1.8234	44.0	127.2	117.8	55.0	17.2	3.5	8,266

These calibrations reveal that total net migration to Contra Costa County declined sharply between 1960 and 1975. In particular, migration dropped from 39,559 between 1965 and 1970 to 8,266 between 1970 and 1975. Total fertility also declined dramatically, from 3.19 for 1960-1965 to 1.82 for 1970-1975.

To provide a varied selection of projected net migrations several interpolated age-sex distributions were developed from the calibrations displayed by Table 11. These interpolated or "synthetic" distributions were derived by averaging the net migration for two or more 5-year calibration sets. This procedure appears methodologically sound since the age-specific migration is basically independent of the size of the existing cohort. The propensity of persons outside the county to in-migrate is determined by a variety of local and regional factors. For example, a positive correlation has been noted between prosperous economic conditions and net immigration. The level of fertility is another factor with a positive relationship to net migration. Table 12 illustrates how a synthetic migration distribution was developed by averaging the basic migration distributions for the three five-year periods between 1960 and 1975. A complete set of basic and derived migration functions is presented in Table 13.

Selecting Alternative Population Growth Scenarios

The culmination of the calibration of fertility and migration is to select ranges of birth and death rates and net migration for projecting alternative future populations. As noted, these projections usually include a low, medium, and high range, in order to ensure a reasonable probability of encompassing the actual future population. In addition, there may be an extreme low projection, which combines all the assumptions most adverse to growth, and an extreme high which combines all the assumptions most conducive to growth.

Selection of various growth scenarios is made by selecting diverse combinations of total fertility and net migration. Table 14 contains 40 possible combinations based on the updated county vital rates. Each combination represents a unique combination of total fertility and net migration derived from historic trends. Each migration level represents either an amount of migration actually

TABLE 12
DERIVATION OF COUNTY NET MIGRATION:
1960-1975

	1960-1965	1965-1970	1970-1975	(Average)	Percent Distribution
Males	22,389	19,112	6,678	16,279	49.8
0-4	4,533	2,172	-287	2,139	6.6
5-9	4,178	3,754	1,685	3,205	9.8
10-14	2,729	2,343	1,298	2,123	6.5
15-19	-648	-991	-1,969	-1,202	-3.7
20-24	-2,137	-3,928	-5,698	-3,921	-12.0
25-29	3,702	5,614	4,279	4,531	13.9
30-34	2,194	4,278	4,299	3,590	11.0
35-39	2,389	3,632	2,503	2,841	8.7
40-44	2,408	1,546	1,830	1,928	5.9
45-49	857	95	371	441	1.4
50-54	773	667	341	594	1.8
55-59	285	-143	-486	-115	-0.4
60-64	340	176	-853	112	0.3
65-69	99	-530	146	-95	-0.3
70-74	147	198	-146	66	0.2
75-79	452	125	-210	122	0.4
80-84	96	-167	-208	-93	-0.3
85+	-9	267	-218	13	0.0
Total Females	26,977	20,447	1,589	16,338	50.2
0-4	4,655	2,899	-448	2,369	7.3
5-9	5,084	3,709	1,286	3,026	9.3
10-14	2,885	2,523	346	1,918	5.9
15-19	-123	-1,264	-3,049	-1,479	-4.5
20-24	-333	-2,165	-4,835	2,444	-7.5
25-29	3,736	5,403	4,439	4,526	13.9
30-34	2,660	3,901	4,094	3,552	10.9
35-39	2,299	2,418	1,949	2,222	6.8
40-44	2,449	1,097	1,406	1,651	5.1
45-49	684	-448	-547	-104	-0.3
50-54	777	623	-352	349	1.1
55-59	375	-139	-1,564	-443	-1.4
60-64	491	558	-875	58	0.2
65-69	631	519	590	580	1.8
70-74	505	495	15	338	1.0
75-79	820	225	-231	271	0.8
80-84	325	-204	-306	-62	-0.2
85+	4	295	-329	-10	0.0
Total Net Migration	49,312	39,559	8,266	32,617	100.0%

TABLE 13
ALTERNATIVE COUNTY MIGRATION DISTRIBUTIONS

	Time Periods							
	1960-1965	60-65 65-70	1965-1970	60-65 65-70 70-75	60-65 70-75	65-70 70-75	65-70 70-75	1970-1975
Total Net Migration (in thousands)	49	44	40	33	29	24	16	8
Percent Male	45.4	46.8	48.3	49.8	50.6	53.9	60.8	80.8
0-4	9.2	7.5	5.5	6.6	7.4	3.9	2.0	-3.5
5-9	8.5	8.9	9.5	9.8	10.2	11.4	13.7	20.4
10-14	5.5	5.7	5.9	6.5	7.0	7.6	9.7	15.7
15-19	-1.3	-1.8	-2.5	-3.7	-4.5	-6.2	-10.7	-23.8
20-24	-4.3	-6.8	-9.9	-12.0	-13.7	-20.1	-32.7	-68.9
25-29	7.5	10.5	14.2	13.9	13.9	20.7	28.7	51.8
30-34	4.4	7.3	10.8	11.0	11.3	17.9	26.7	52.0
35-39	4.8	6.8	9.2	8.7	9.5	12.8	17.3	30.3
40-44	4.9	4.4	3.9	5.9	7.4	7.1	10.9	22.1
45-59	1.7	1.1	0.2	1.4	2.1	1.0	1.9	4.5
50-54	1.6	1.6	1.7	1.8	1.9	2.1	2.6	4.1
55-59	0.6	0.2	-0.4	-0.4	-0.4	-1.3	-2.5	-5.9
60-64	0.7	0.6	0.4	0.3	-0.9	-1.4	-3.7	-10.3
65-69	0.2	-0.5	-1.3	-0.3	0.4	-0.8	-0.1	1.8
70-74	0.3	-0.5	0.5	0.2	0.0	0.1	-0.4	-1.8
75-79	0.9	0.7	0.3	0.4	0.4	-0.2	-0.8	-2.5
80-84	0.2	-0.1	-0.4	-0.3	-0.2	-0.8	-1.2	-2.5
85+	0.0	0.3	0.7	0.0	-0.4	0.1	-0.6	-2.6
Percent Female	54.7	53.2	51.7	50.2	49.4	46.1	39.2	19.2
0-4	9.4	8.4	7.3	7.3	7.3	5.1	2.4	-5.4
5-9	8.3	8.8	9.4	9.3	9.3	10.4	11.8	15.6
10-14	5.9	6.1	6.4	5.9	5.7	6.0	5.5	4.2
15-19	-0.2	-1.6	-3.2	-4.5	-5.5	-9.0	-16.2	-36.9
20-24	-0.7	-2.8	-5.5	-7.5	-9.0	-14.6	-25.9	-58.5
25-29	7.6	10.2	13.7	13.9	14.2	20.6	29.1	53.7
30-34	5.4	7.4	9.9	10.9	11.7	16.7	25.1	49.5
35-39	4.7	5.3	6.1	6.8	7.4	9.1	12.8	23.6
40-44	5.0	4.0	2.8	5.1	6.7	5.2	8.3	17.0
45-49	1.4	0.3	-1.1	-0.3	0.3	-2.1	-3.3	-6.6
50-54	1.6	1.6	1.6	1.1	0.7	0.7	-0.7	-4.3
55-59	0.8	0.3	-0.4	-1.4	-2.1	-3.6	-7.5	-18.9
60-64	1.0	1.2	1.4	0.2	-0.7	-0.7	-3.2	-10.6
65-69	1.3	1.3	1.3	1.8	2.1	2.3	3.6	7.1
70-74	1.0	1.1	1.3	1.0	0.9	1.1	0.8	0.2
75-79	1.7	1.2	0.6	0.8	1.0	0.1	-0.7	-2.8
80-84	0.7	0.1	-0.5	-0.2	0.0	-1.1	-1.7	-3.7
85+	0.0	0.3	0.7	0.0	-0.6	-0.1	-1.1	-4.0

*Denotes a "synthetic" or net migration total which is the average of total migration during two or more preceding time periods.

TABLE 14
POSSIBLE ALTERNATIVE COMBINATIONS OF TOTAL FERTILITY AND NET MIGRATION

Total Fertility Rates			Total Net In-Migration (1,000's)							
Series*	1975-1980	2015+	8	16	24	29	33	40	44	49
6	1.56	1.55	1	2	3	4	5	6	7	8
8	1.65	1.73	9	10	11	12	13	14	15	16
5	1.75	1.92	17	18	19	20	21	22	23	24
7	1.86	2.19	25	26	27	28	29	30	31	32
4	1.98	2.46	33	34	35	36	37	38	39	40

*Series are based on combinations of unique updated county vital rates.

TABLE 15
SUMMARY OF RECENT DEMOGRAPHIC TRENDS IN CONTRA COSTA COUNTY

Time Period	Average Fertility Rate	Average Net Migration Per 5 Years	Approximate Percent Increase Per 5 Years	Closest Growth Rate Combination From Table 12
1960-65	3.13	49,000	20%	40
1965-70	2.44	40,000	14%	38
1970-75	1.82	8,000	5%	9 or 17
1960-70	2.82	44,500	17%	39
1965-75	2.13	24,000	10%	27
1960-75	2.48	33,000	12%	37

experienced for 1960-1965, 1965-1970, 1970-1975, or a unique combination of these years (see Table 12). Not all of the combinations may be logical or useful for projection purposes; however, they are all available.

In selecting future fertility and migration rates it is helpful to examine historic data. Table 15 summarizes the demographic data for the past fifteen years, and relates it to the combinations of Table 14. Thus, for example, combination #38 could be used to produce a population projection based on growth patterns similar to the 1965-70 period.

Rate Selection Criteria

Historically, county birth rates and migration have been positively correlated; i.e., high birth rates have been accompanied by high net migration. An expansive economic climate (1960-65) appears conducive to larger families and in-migration vis-a-vis housing construction and employment opportunities; a sluggish economy such as 1970-1975 is associated with both lower birth rates and lower net migration. Therefore, this positive correlation should be reflected in the selection of projection rates.

The 1960-65 period represented a higher growth pattern than can reasonably be expected in the future. The total fertility of 3.13 births per woman is not likely to recur due to the significant changes in family planning practices that have occurred during the last decade. The migration rate for this period is also not likely to recur since the early sixties were a period when land was readily available for housing construction and rapid urban growth. Since that time, environmental considerations, increased building costs, and limited availability of land have moderated the pace of development.

The 1970-75 period represents a below-normal growth pattern for the county. The low rate of 1.82 births per woman is partly explained in terms of postponed fertility, some of which may be compensated for by births in the next 5 to 10 years. The low net migration reflects the sluggish economic conditions prevalent in this period; it was a period of tight money, inflation, and persistent

unemployment. Consequently new construction, particularly of multiple housing units, decreased. Reflecting these general conditions, migration to the county also declined.

The 1975-80 population projection period is unique since part of it has already occurred and we can examine the general magnitude of the rates for this period. It is already apparent that some of the adverse economic conditions of the 1970-1975 period will continue into the 1975-80 period. Consequently, a low to moderate growth scenario seems likely for this period.

Table 16 contains a summary of the rates selected for testing. These series represent the following specific growth scenarios:

Hx Series - Extreme High Projection

This series assumes a return to conditions similar to those of the 1960-70 decade. An ultimate fertility of 2.20 is projected (Series 7). Although this is somewhat lower than the levels for both the 1960-65 and 1965-70 periods, trends in family size and the widespread use of family planning techniques indicate that an ultimate fertility of 2.20 is the highest rate which has any reasonable likelihood of occurrence. Net in-migration is set at 33,000 per 5 years, a rate representative of the average during the fifteen years 1960 to 1975. The 5 year high of 49,000 (1960-65) was rejected as being too high for future projections, even in the extreme high series.

The extreme high projection is intended as a comparative analysis illustrating what would occur if conditions favorable to very rapid growth were to return and persist indefinitely. The likelihood of such an occurrence is very low, and the Hx projection is somewhat academic from a planning perspective.

H Series - High Projection

This projection represents a "reasonable" high; i.e., one that is definitely achievable. Under its assumptions, fertility increases to 2.20 (Series 7) and migration is set at 25,000, the level of migration projected for Contra Costa County by the State Department of Finance Population Research Unit. Although initial projections utilized a net migration figure of 24,000, it was decided to use the State's figure of 25,000 in order to provide comparability. This series should be useful for the planning of facilities and programs for which the costs or consequences of under-investment are severe. For example, capital investment in criminal justice facilities or health care facilities could be keyed to this projection since it forecasts the probable maximum number of youth and young adults. By planning for these population levels the County would

TABLE 16
VITAL RATES WITHIN ALTERNATIVE
CONTRA COSTA COUNTY POPULATION PROJECTIONS: 1975-2000

Projection Series	Vital Rates	Time Period 1975-80	1980-85	1985-90	1990-95	1995-2000
Extreme High						
	BR[1]	1.86	2.06	2.16	2.20	2.20
	NM[2]	33	33	33	33	33
High						
	BR	1.86	2.06	2.16	2.20	2.20
	NM	25	25	25	25	25
Medium						
	BR	1.75	1.87	1.91	1.93	1.92
	NM	25	25	25	25	25
Low						
	BR	1.65	1.72	1.74	1.74	1.74
	NM	25	25	25	25	25
Extreme Low						
	BR	1.56	1.57	1.56	1.56	1.56
	NM	16	16	16	16	16
ABAG Base Case 1[3]						
	BR	1.70	1.79	1.82	1.83	1.83
	NM	44.7	44.7	44.7	44.7	44.7
ABAG Base Case 2[3]						
	BR	1.56	1.57	1.56	1.56	1.56
	NM	22.5	22.5	22.5	22.5	22.5

[1] Birth Rate, expressed as Total Fertility.
[2] Net Migration, in 1000's per 5 year period.
[3] ABAG published projections only to the year 1990; figures for the 1990-2000 period are based on a continuation of the 1975-1990 trends.

minimize the risk of having inadequate correctional or health care facilities in the future. Multiple purpose structures should be designed for this population so that they may be converted to other uses if the population is less than projected.

M Series - Medium Projection

The M-Series - Medium Projection appears to be the county's "best bet" for the future. This projection utilizes Series 5 fertility rates, which show fertility increasing to 1.92. This fertility rate series is the county series which was developed from the national mid-range, replacement level series (Series 2). Net migration is set at 25,000 per 5 years, the level projected by the State. This level of migration is approximately equivalent to the average rate for the 1965-1975 period.

L-Series - Low Projection

This projection represents a "reasonable low". The fertility rate is assumed to increase slightly from current levels to 1.74 (Series 8), a rate well below the replacement fertility rate of 2.1. Migration is set at 25,000 per 5 years, in accordance with the State's projections.

Lx Series - Extreme Low Projection

This series was developed to examine the consequences of continuing the low growth rate of the last five years (1970-75). Fertility is projected at 1.55 (Series 6), slightly below the annual rates experienced in 1974 and 1975. Migration is projected at 16,000 per 5 years, double the 1970-75 level, but substantially less than the State's projected migration or the experience of the 1960 decade.

This extreme low series represents the lowest population projection consistent with possible, albeit somewhat extreme, demographic assumptions. The fertility rates assume a permanent level which is 0.55 children below

replacement (2.1). This would require a significant departure from historic trends in family formation rates and completed family size. The migration level is likely to occur only if the county continues to be affected by adverse economic conditions.

ABAG Base Cases 1 and 2

At the time these series of population projections were being developed, the Association of Bay Area Governments released a provisional set of population, land use, housing unit and employment projections for the Bay Area. Included in these "Provisional Series 3 Projections" were population projections for Contra Costa County for the year 1990. It was decided to use the population model to develop projections paralleling the two Series 3 projections, Base Cases 1 and 2. In so doing, ABAG's birth rate assumptions were utilized, along with the model's survival rates. The 1990 projection were known (these were the ABAG Series 3 projections), but net migration was not. Consequently, net migration was varied until the appropriate 1990 projections were obtained. It should be noted that the Series 3 projections were included only for reference purposes.

TABLE 17
SUMMARY OF ALTERNATIVE COUNTY POPULATION PROJECTIONS: 1980-2000

Projection Series	Year				
	1980	1985	1990	1995	2000
Extreme Low	613,720	643,817	669,779	689,041	701,000
Low	625,004	668,161	708,181	742,028	769,410
Medium	627,213	674,047	718,323	756,397	788,236
High	629,938	681,526	731,782	776,095	814,638
Extreme High	638,142	698,419	758,261	813,079	863,225
ABAG Base Case 1[1]	645,861	711,016	773,784	831,276	884,071
AGAB Base Case 2[1]	620,356	657,383	690,816	718,116	738,725

[1] ABAG published projections only to the year 1990; figures for 1995 and 2000 are based on a continuation of the 1975-1990 trends.

TABLE 18
SUMMARY OF MOST PROBABLE POPULATION
PROJECTIONS FOR CONTRA COSTA COUNTY: 1975-2000
(MEDIUM PROJECTION SERIES)

Age Group	1975[1]	1980	1985	1990	1995	2000
0-4	37,683	42,767	48,225	48,831	46,003	43,497
5-9	48,939	43,022	48,093	53,539	54,147	51,330
10-14	59,886	52,255	46,349	51,413	56,853	57,461
15-19	56,310	55,869	48,270	42,384	47,439	52,861
20-24	41,981	47,265	46,828	39,285	33,437	38,469
25-29	46,673	52,018	57,272	56,842	49,356	43,548
30-34	45,520	55,001	60,312	65,540	65,121	57,695
35-39	38,583	50,587	60,002	65,274	70,473	70,070
40-44	36,328	41,140	53,010	62,329	67,547	72,702
45-49	35,826	35,274	40,010	51,670	60,839	65,971
50-54	37,980	35,337	34,823	39,440	50,781	59,718
55-59	29,141	34,853	32,372	31,908	36,347	47,219
60-64	22,387	24,430	31,782	29,518	29,117	33,300
65-69	17,719	20,346	24,016	28,886	26,894	26,563
70-74	11,942	15,780	18,146	21,432	25,823	24,132
75-79	7,994	9,797	12,991	15,000	17,770	21,507
80-84	4,775	5,390	6,732	9,105	10,628	12,709
85+	3,162	4,083	4,814	5,927	7,824	9,486
TOTAL	582,829	627,213	674,047	718,323	756,397	788,236

[1]Actual figures according to 1975 Special Census of Contra Costa County.

Prepared by Contra Costa County Planning Department.

SUMMARY AND CONCLUSIONS

This Technical Memorandum has described the formulation, rationale, structure, and application of the Contra Costa County Population Model. Use of the cohort survival technique to project the age and sex composition of the county's population at five-year intervals during the period 1975-2000 was described under alternative fertility, migration, and survival rate assumptions. The projections bracket what is argued to be the most probable population growth scenario. The most probable growth scenario results in a total county population of 627,213 by 1980; 718,323 by 1990; and 788,236 by the year 2000.

There are significant planning implications associated with all of the population projections. In particular, the increase of some 200,000 persons forecast by the Medium projection (considered the most probable growth scenario) will require a substantial increase in housing units and land utilization. The character of the increase in land utilization depends on the general and small area plans that are developed to meet this demand. To the extent that land use plans have already been prepared, the implied pattern of development may be subject to advance public consideration and debate. Further, as greater recognition is given to the need to examine the total costs of development, it can be expected that the fiscal impact of expected future population growth will be given consideration.

Additional factors which planners may consider include the impact of population growth on the demand for energy resources. In the context of diminishing energy supply and rapidly increasing costs, government and public utility planners may develop partnerships to determine relationships between future development and total consumption. In general, the population projections strongly suggest the need for coordinated advance planning in order to consider the numerous issues associated with population growth and change.

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